1.6.3 Physical Infrastructure

Introduction

The National Institute for Occupational Safety and Health has many unique physical resources that provide researchers with the tools and environment to conduct world-class research in solving the health and safety problems affecting our nation's mine workers. These physical resources include state-of-the-art laboratories, one-of-a-kind facilities, and research mines. The research mines, and a number of the facilities and laboratories, allow researchers to conduct full-scale experiments before testing an intervention at a working mine site. NIOSH maintains and operates these facilities according to applicable standards and practices.

Pittsburgh Research Laboratory

Spokane Research Laboratory

This section lists the physical infrastructure resources of the NIOSH Mining Research Program. For the purposes of this information system, these resources are organized into the categories of Facilities, Laboratories, and Major Equipment:

- **Facilities** are locations which do not have a formal Standard Operating Procedure (SOP) or Protocol
- **Laboratories** are locations which have a formal SOP, or Protocol
- **Major Equipment** are the more important equipment associated with a laboratory or facility

Lake Lynn Laboratory

The site listed for each resource is its actual physical location, and is either PRL (Pittsburgh Research Laboratory), SRL (Spokane Research Laboratory), LLL (Lake Lynn Laboratory), or MIS (Missile Test Site).

Missile Test Site

The Pittsburgh Research Laboratory (PRL) site is 13 miles south of Pittsburgh. It consists of a 180-acre campus with a number of office and laboratory structures, along with an Experimental Mine and Safety Research Coal Mine. The Experimental Mine was developed in 1910 when the US Bureau of Mines was established, mainly to study coal mine fires and explosions. The Safety Research Coal Mine, which became operational in the early 1970s, is a room-an-pillar operation about the size of a working section in a commercial coal mine. Other unique facilities at PRL include the Mine Roof Simulator, the Acoustical Testing Laboratory, the Full-Scale Longwall Dust Gallery, and the Human Performance Research Mine.

The Spokane Research Laboratory (SRL) site is located just north of the downtown Spokane, Washington business area. It consists of a 2-story office and laboratory complex and associated buildings. One major equipment, the IMPAC 3636 Mark II free fall shock testing machine, is used to simulate impulsive forces experienced by heavy equipment operators that may contribute to sprains and strains and other lower back injuries.

The Lake Lynn Laboratory (LLL) is located 50 miles southeast of Pittsburgh. It consists of an underground limestone mine and surface quarry area. The underground mine portion is a sophisticated underground facility for conducting large-scale explosion trials and mine fire research. Entries are sized to match those of commercial mines, making them authentic, full-scale test galleries. Other facilities located at LLL are the Hydrostatic Testing Chambers for Mine Seals, the Fire Gallery, the Fire Suppression Facility, and the Explosives Testing Site.

The Missile Test Site (MIS) is an old Department of Defense missile launch location about 20 miles west of Spokane. This site consists of 20 acres of land and an underground and surface building complex. The site allows for various full-scale experiments to be conducted to support the mining research program. A unique laboratory is the Dynamic Materials Testing Laboratory, developed to characterize the response of rock to explosive loading.

Facilities

13 Facilities

Site	Facility	Purpose	Strategic Goals
PRL	Anechoic Chamber	Provides a reflection free environment for acoustic testing	Hearing loss
PRL	Bombproof 142	Assessing the quality and performance characteristics of explosive materials	Traumatic injuries
LLL	DC Trolley Railway System	A test bed for experiments involving DC trolley/track haulage equipment	Traumatic injuries
PRL	Explosives Testing Pond	Underwater testing of explosives	Traumatic injuries
LLL	Explosives Testing Site (Plateau)	Explosives testing	Traumatic injuries
LLL	Explosives Testing Site (Upper Quarry)	Explosives testing	Traumatic injuries
LLL	Fire Gallery	Evaluating the fire hazards of mine materials; fire fighting	Mine disasters
LLL	Fire Suppression Facility	A large-scale, state-of-the-art fire test facility	Mine disasters
PRL	Human Performance Research Mine	Simulating mining tasks and determining potential interventions for tasks with exposures to ergonomic risk factors	Cumulative injuries; Traumatic injuries
LLL	Lake Lynn Experimental Mine	Large-scale explosion trials and mine fire research	Ground control; Mine disasters; Respiratory diseases
LLL	Mine Fire Preparedness Facility	Evaluating technology and methods for fire suppression and conducting firefighting training	Mine disasters
PRL	Safety Research and Experimental Coal Mines	Testing new procedures and technologies in a mine setting	Cumulative injuries; Ground control; Hearing loss; Mine disasters; Respiratory diseases
LLL	Simulated Underground Mine Facility	A simulated borehole and underground coal mine entry for studying mining techniques and processes	Mine disasters

Laboratories

30 Laboratories

Site	Laboratory	Purpose	Strategic Goals
PRL	Acoustical Testing Laboratory	Sound power level testing of large mining and construction equipment	Hearing loss
PRL	Aerosol Physics Laboratory	Testing and development of new aerosol monitoring instruments	Respiratory diseases
PRL	Auditory Research Laboratory	Sound-treated room and hearing-protector test chamber for conducting hearing loss research	Hearing loss
SRL	Chemistry Laboratory	Provides a range of wet chemistry techniques to develop both lab-based and field- portable analytical methods	
PRL	Diesel/Aerosol Research Laboratory	Analysis of diesel samples collected in the laboratory and field for elemental and total carbon and creation of an aerosol atmosphere simulating that seen in an underground mine	Respiratory diseases
MIS	Dynamic Materials Testing Laboratory	Characterization of the response of rock to explosive loading	Ground control
PRL	Full Scale Continuous Miner Dust Gallery	Evaluation of technologies for control of respirable dust and face methane gas on continuous mining machines	Respiratory diseases
PRL	Full Scale Face Ventilation Gallery	Evaluation of the effectiveness of face ventilation systems for removing and diluting methane gas liberated at the face and sampling methodologies used to assess face methane levels	Mine disasters
PRL	Full Scale Longwall Dust Gallery	Development and testing of new dust control technologies for longwall mining operations in underground coal mines	Respiratory diseases
PRL	Gas Content Testing Laboratory	Measurement of the methane content of coal core samples	Mine disasters
PRL	Hearing Loss Prevention Unit	Mobile lab for taking hearing loss prevention research to workers and their families	Hearing loss
PRL	Hemi-Anechoic Laboratory	Noise source identification testing	Hearing loss
SRL	Human Factors Engineering Laboratory	Evaluating and reducing musculoskeletal injuries resulting from improper design of mobile mining equipment	Cumulative injuries
LLL	Hydrostatic Testing Chambers for Mine Seals	Full scale pressure loading of mine ventilation seals	Mine disasters
SRL	Industrial Hygiene Laboratory	Provides support for industrial hygiene field investigations and projects	
SRL	Instrumentation Laboratory	Designing and constructing prototype instruments in support of research	Ground control
LLL	Lake Lynn Cannon Gallery	Evaluating the hazards of explosives in a flammable gas and/or combustible dust atmosphere	Mine disasters
LLL	Lake Lynn Diesel Laboratory	Evaluation of diesel emissions control technologies and characterization of ultrafine and nanometer aerosols and gases emitted by diesel-powered vehicles	Respiratory diseases

Site	Laboratory	Purpose	Strategic Goals
PRL	Microbalance Laboratory	Gravimetric analysis of dust samples	Respiratory diseases
PRL	Mine Electrical Laboratory	A safe, secure, and properly equipped facility for conducting mine electrical safety research	Traumatic injuries
PRL	Motion Analysis Laboratory	Testing new work methods and equipment in an environment that minimize risk of injury and permits the collection of data with instrumentation not suitable for use in a mine environment	Cumulative injuries; Traumatic injuries
PRL	MTS Rock Mechanics Testing Laboratory	Small scale testing of materials	Ground control
PRL	Physical Strength Laboratory	Measuring the static and dynamic physical strength capabilities of mine workers	Cumulative injuries
PRL	Safety Structures Testing Laboratory	Large scale material and structural testing to prevent roof and rib falls	Ground control
SRL	Seismic Laboratory	Supports field measurement and analyses of seismic event activity produced by dynamic rock mass failures	Ground control
PRL	Sensors Laboratory	Testing wearable sensors and wireless networks for real-time protection of miners from work related hazards	Traumatic injuries
SRL	Soil/Rock Properties Laboratory	Provides the capability to wash, screen, dry, and mix unconsolidated materials such as soils prior to testing by various test frames	Ground control
PRL	Toxic Fumes Laboratory (Surface)	Determining the toxic fumes produced by high explosives	Traumatic injuries
PRL	Toxic Fumes Laboratory (Underground)	Detonation of large, confined charges in a controlled volume and sampling of the resulting fumes	Traumatic injuries
PRL	Whole Body Vibration Laboratory	Measuring whole body vibration exposure and testing seating and suspension systems that isolate equipment operators from vehicle vibrations	Cumulative injuries; Traumatic injuries

Major Equipment

35 Major Equipment Resources

Site	Equipment	Purpose	Facility	Laboratory	Building	Strategic Goals
PRL	20-Liter Explosion Chamber	Measuring the explosion characteristics of dusts, gases, and hybrid mixtures			143	Mine disasters
MIS	60 mm Split Hopkinson Pressure Bar	Measuring the dynamic strength attenuation of materials used in close proximity to blasting		Dynamic Materials Testing Laboratory		Ground control
SRL	AMTI Biomechanics Platform	Study of landing forces (as operator exits from the cab) and postural stability and their relationship to musculoskeletal injuries		Human Factors Engineering Laboratory		Cumulative injuries
PRL	Bruel & Kjaer Investigator 2260 Hand-Held Analyzer	A hand-held, 2-channel analyzer capable of making broadband and real-time octave band measurements			154	Hearing loss
PRL	Bruel & Kjaer Investigator 2260 with Sound Intensity Probe	Measuring the sound intensity radiating off of an object or machine; locating noise sources on complex pieces of machinery			155	Hearing loss
PRL	Bruel & Kjaer PULSE Multi-Analyzer System	A multi-channel data acquisition system that provides real time acoustical data collection and analysis		Acoustical Testing Laboratory	154	Hearing loss
SRL	Direct Shear Test Frame	Biaxial testing on rock, concrete, and soil samples from 1 inch square to 14 inch blocks		Soil/Rock Properties Laboratory		Ground control
MIS	Drilling Equipment	Provides the ability to obtain core samples and to install test equipment both on the surface and underground				Ground control

Site	Equipment	Purpose	Facility	Laboratory	Building	Strategic Goals
PRL	Earthen Bermed Magazines	Magazines for safe storage of explosives				Traumatic injuries
SRL	Fiber Panel Testing Device	Portable field testing device for gathering information on initial breaking strengths of shotcrete		Soil/Rock Properties Laboratory		Ground control
PRL	Fletcher HDDR-13-C-F Roof Bolting Machine	Testing noise controls for roof bolting machines to determine effectiveness of the controls in a laboratory environment prior to testing in operating mines			152	Cumulative injuries; Ground control; Hearing loss
PRL	Frictional Ignition Apparatus	Studying frictional ignitions and methods to prevent their occurrence			152	Mine disasters
PRL	Hipotronics 100-KV AC and DC High Voltage Sources	Provides electrical power for experiments where high voltages must be applied to electrical power system components such as mine electrical cables		Mine Electrical Laboratory	151	Traumatic injuries
PRL	Hipotronics 750-KVA Three-Phase and DC Power Source	Provides electrical power for experiments involving power system components such as electrical cables, motors, and circuit protection devices		Mine Electrical Laboratory	151	Traumatic injuries
SRL	ICP Plasma Spectrometers	??		Chemistry Laboratory		
SRL	IMPAC 3636 Mark II Free Fall Shock Testing Machine	A free-fall testing machine that can perform a wide range of shock tests		Human Factors Engineering Laboratory		Cumulative injuries
PRL	Joy 14CM9 Continuous Mining Machine	To study mining tasks and machine interventions related to continuous mining operations			152	Hearing loss; Traumatic injuries

Site	Equipment	Purpose	Facility	Laboratory	Building	Strategic Goals
PRL	Joy 3FCT-4 Flexible Conveyor Train	A continuous haulage system used to study mining tasks and machine safety			152	Traumatic injuries
PRL	Large Fumes Chamber	Determining toxic fumes produced by explosives		Toxic Fumes Laboratory (Surface)	117	Mine disasters
PRL	Large Spherical Explosion Chamber	Measuring the explosion characteristics of gases and the toxic fumes produced from the detonation of high explosives		Toxic Fumes Laboratory (Surface)	117	Mine disasters
PRL	LMS Pimento Portable Noise and Vibration Analyzer	A portable device for measuring sound pressure levels, vibration, and frequency response functions of a structure in the field			154	Hearing loss
PRL	MB Dynamics 110 Electromechanical Shakers	Pinpointing areas on structures that have the highest vibrations			153	Hearing loss
SRL	Million Pound Compression Test Frame	Testing specimens up to 6 inches in diameter for determining unconfined compressive strength and rock modulus		Soil/Rock Properties Laboratory		Ground control
PRL	Mine Roof Simulator	Evaluating the integrity, stability, and load performance of large structures and equipment		Safety Structures Testing Laboratory	155	Ground control
LLL	Mobile Diesel Powered Propeller Fan	A mobile, self-sufficient source of ventilation airflow for performing on-site research in specific areas of large-opening underground mines, independent of the operator´s infrastructure	Lake Lynn Experimental Mine			Mine disasters; Respiratory diseases

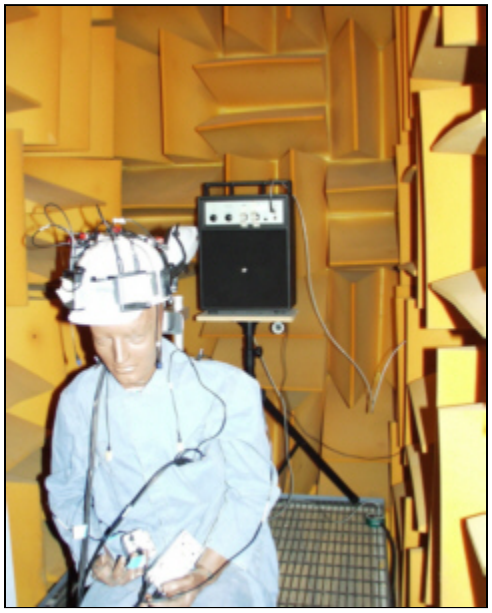
Site	Equipment	Purpose	Facility	Laboratory	Building	Strategic Goals
PRL	Motion Analysis Eagle i Motion Analysis Capture System	Quantitative assessment of a subject´s task by providing comparative or absolute measurement of various motions involved in the task		Motion Analysis Laboratory	152	Cumulative injuries; Traumatic injuries
PRL	OROS OR38 Multi-Analyzer/Recorder	A portable, 8-channel device for measuring sound and vibration level in 1/3-octave bands			154	Hearing loss
SRL	Programmable Controlled Tension-Compression Test Frame	Cyclic loading for earthquake simulation and fatigue evaluations		Soil/Rock Properties Laboratory		Ground control
PRL	Robotron 50-KA High Current Source	Provides electrical current for testing power system components such as fuses, circuit breakers, and conductors		Mine Electrical Laboratory	151	Traumatic injuries
PRL	Scanning Electron Microscope And X-Ray Elemental Analysis System	High-resolution imaging and x-ray elemental analyses of particles and other solids related to mine explosion research and forensic studies			143	Mine disasters
PRL	Servo Controlled MTS Load Frame	Materials testing		MTS Rock Mechanics Testing Laboratory	156	Ground control
LLL	Small Scale Burn Tunnels	Evaluating combustible materials and ventilation impact in mine atmospheres				Mine disasters
PRL	Temporary Magazine	Magazine for explosives received after hours				Traumatic injuries
SRL	Tension-Compression Test Frames	Measuring the physical properties of materials		Soil/Rock Properties Laboratory		Ground control
PRL	Vibration Table	Studying whole body vibration		Whole Body Vibration Laboratory	153	Cumulative injuries; Traumatic injuries

NIOSH Mining Facility

Anechoic Chamber

The Anechoic Chamber provides a reflection free (free-field) environment for acoustic testing. It is 1.3m wide by 2.6m long by 2.3m high interior wedge tip to wedge tip. The wedges are .71m long which yields a low frequency cut-off of 120 Hz. The chamber was recently used in an experiment to determine the effects of sound source position on measured noise exposure. For the experiment, it was necessary to insure that measurements were made in an environment that was free of acoustic reflections down to 150 Hz. The anechoic chamber provided the ideal location for these tests. The chamber can also be used for measuring the sound power of small devices.

Strategic Goals: Hearing loss
Site: Pittsburgh Research Laboratory
Building: 154



Interior of anechoic chamber

NIOSH Mining Facility

Bombproof 142

This bombproof facility is used to conduct experiments that examine both quality and performance characteristics of explosive materials. The facility can totally contain the detonation of 5 lb of explosives and has provisions for electronic instrumentation.

Strategic Goals: Traumatic injuries
Site: Pittsburgh Research Laboratory
Building: 142

The Bombproof facility

NIOSH Mining Facility

DC Trolley Railway System

The DC Trolley Railway System provides a test bed for experiments involving DC trolley/track haulage equipment. A 300-kW, 300-V DC rectifier supplies power to the system which features 4/0 AWG, figure-eight trolley wire and 42 in gauge track. A 316 ft straightaway is installed on a 4% grade. A 10-ton locomotive and several 10 ton rotary dump cars, stored on a 130 ft spur, are available for use.

Strategic Goals: Traumatic injuries
Site: Lake Lynn Laboratory

A mine locomotive is operated up the sloped track at the Lake Lynn Railway

NIOSH Mining Facility

Explosives Testing Pond

The Pittsburgh Research Laboratory possesses a 177-ft diameter, 25-ft deep pond in which underwater shots of explosives may be conducted. The pond was constructed specifically for explosives research. Underwater testing of explosives is a standard technique for determining the strength of an explosive. Typically, a 10-lb explosive charge is lowered into the pond, with pressure transducers suspended in the water nearby to record the pressure pulses produced by the detonation.

Strategic Goals: Traumatic injuries
Site: Pittsburgh Research Laboratory

Explosives Testing Pond

NIOSH Mining Facility

Explosives Testing Site (Plateau)

The plateau Explosives Testing Site is located off of the road leading to the fan house at the Lake Lynn Laboratory. This area was originally constructed to provide increased environmental controls for several of the explosive burn tests. The site consists of a 125-ft by 125-ft concrete pad. The pad has been constructed so that all drainage off the concrete pad can empty into a 500 gallon concrete tank; this provides for environmental containment in the event of a spill. A 16-ft high woven wire fence with gates surrounds the concrete pad; this fence assists in containing debris that may be ejected during a burn test and secures the area between tests. An instrument shed is located a safe distance away from this test site to serve as the control center. Power is provided to the site through underground lines. This site can be used for many other types of research where a large, secured area is needed.

Strategic Goals: Traumatic injuries
Site: Lake Lynn Laboratory

Researcher assessing the condition of a detonator transport container following a burn at the Explosives Testing Plateau

NIOSH Mining Facility

Explosives Testing Site (Upper Quarry)

The Explosives Testing Site located in the upper quarry section of the Lake Lynn Laboratory occupies approximately 50,000 ft^2 of gently sloping quarry bottom and is separated from the Mine Fire Preparedness Facility by a 50-ft high earthen berm which provides protection during the testing of explosives. This explosives area contains a 1,000 ft^3 horizontal gallery and two vertical galleries, several specially constructed bunkers, a 25-ft-high, 15-ft-wide steel retaining wall, a 12-m drop tower with electric winch and lift magnet, and concrete burn pads. Natural gas, power, and instrument lines are installed to several of these test facilities. Video cable is also installed to this area to permit viewing of the explosive tests from a safe vantage point or from within the Main Office building. An instrumentation control shed is located on the other side of the earthen berm. A secured explosive magazine site is also available to facilitate the explosive studies.

Strategic Goals: Traumatic injuries
Site: Lake Lynn Laboratory
Laboratories: Lake Lynn Cannon Gallery

Dust explosion venting from the large vertical gallery; 12-m drop tower can be seen in the background

NIOSH Mining Facility

Fire Gallery

The Fire Gallery consists of a 90 ft long arched roof tunnel that is coupled to a 6 ft diameter axivane fan by a 20 ft transition section. The cross-sectional area of the tunnel is 84 square feet. The tunnel is equipped with temperature sensors and gas sampling lines. Associated structures include a control room/shop trailer and instrumentation shed.

The Fire Gallery is used to evaluate the fire hazards of mine materials, such as conveyor belting, at various air velocities. Conveyor belt samples up to 50 ft in length are mounted on a typical belt structure and ignited at one end by a gas torch or liquid fuel fire. Flame spread rates and downstream gas compositions and temperatures are measured. The Gallery is also used to train fire brigades and mine rescue teams on the proper procedures to fight conveyor belt fires and liquid fuel fires with water lines and high expansion foam in a confined space.

Strategic Goals: Mine disasters
Site: Lake Lynn Laboratory

Firefighter training at the Lake Lynn Fire Gallery

NIOSH Mining Facility

Fire Suppression Facility

The Fire Suppression Facility (FSF) was constructed to evaluate the effectiveness of fire suppression systems for the extinguishment of diesel fuel fires. The fire tunnel is tee-shaped to simulate a crosscut off a main entry. The main entry is 153 ft long and the crosscut is 40 ft long. Each entry is 18 ft wide and 7 ft tall to simulate modern mine entry dimensions. The crosscut area and 75 ft of the main entry are fireproofed and instrumented with thermocouples, gas monitoring instrumentation, and video equipment to monitor fire tests in progress. The FSF has a 2000 gal closed water system, in which all water is collected, filtered, and stored for re-use, to comply with all environmental regulations. In addition, a 100 h.p., pneumatically controlled, variable speed mine fan was installed in the main entry for experiments under ventilated conditions.

The FSF has also been used to study the flammability of mine combustibles under realistic, full-scale conditions. Among the materials evaluated are hydraulic fluids, diesel fuel, noise materials, and conveyor belting. A burn pad was added to the facility in order to conduct full-scale equipment cab fire detection and suppression experiments.

Strategic Goals: Mine disasters
Site: Lake Lynn Laboratory

The Fire Suppression Facility at the Lake Lynn Laboratory

NIOSH Mining Facility

Human Performance Research Mine

Due to the dynamic nature of the mining environment, an actual operating mine is not suitable for most worker task studies. The Human Performance Research Mine allows researchers to study task specific risk factors and ergonomic intervention possibilities in a simulated underground mine setting with actual mining equipment. Studying these tasks and interventions before introducing them to the field helps to ensure useable and effective designs. Each study can be performed with varying seam heights and entry widths. The simulated mine accommodates portable EMG and Motion Analysis systems, making possible detailed research on the physical requirements of mining tasks and the capabilities of mine workers. The research mine is also available to support studies in other NIOSH focus areas.

Strategic Goals: Cumulative injuries; Traumatic injuries
Site: Pittsburgh Research Laboratory
Building: 152

Testing physical requirements and intervention alternatives for roof screening tasks

NIOSH Mining Facility

Lake Lynn Experimental Mine

The Lake Lynn Experimental Mine is a sophisticated underground facility for conducting large-scale explosion trials and mine fire research. The workings are located in a massive limestone deposit. Entries are sized to match those of commercial mines, making them authentic, full-scale test galleries. Movable bulkheads permit the setup of single-entry, triple-entry, and longwall face configurations for experiments. The underground test areas are amply instrumented and coupled to a remote control center at the surface. Research conducted at this facility includes large-scale gas and coal dust explosion studies, conveyor belt flammability trials, and evaluations of explosive materials and mine stoppings. In addition, diesel, ground control, and emergency response and rescue research is conducted here.

Strategic Goals: Ground control; Mine disasters; Respiratory diseases
Site: Lake Lynn Laboratory
Laboratories: Lake Lynn Diesel Laboratory; Hydrostatic Testing Chambers for Mine Seals
Equipment: Mobile Diesel Powered Propeller Fan

Lake Lynn Experimental Mine

NIOSH Mining Facility

Mine Fire Preparedness Facility

The Mine Fire Preparedness Site is in the upper quarry of the Lake Lynn Laboratory. It consists of concrete pads on which various size liquid and/or solid fuel fires can be initiated; a 10,000 gallon water tank, diesel powered water pump, and hydrant; and storage sheds to house fire extinguishers, water hose, nozzles, dry chemical powder, high expansion foam generators, and associated firefighting equipment.

The facility is used to train miners, fire brigades, and mine rescue teams on the extinguishment of liquid and solid fuel fires with portable fire extinguishes, water lines, and high expansion foam. It is also used to conduct experiments on the efficacy of fire suppression agents and firefighting equipment and to evaluate firefighting tactics.

Strategic Goals: Mine disasters
Site: Lake Lynn Laboratory

Firefighting training at the Mine Fire Preparedness Facility

NIOSH Mining Facility

Safety Research and Experimental Coal Mines

Portal of the Safety Research Coal Mine

The Safety Research Coal Mine and Experimental Mine complex is a multi-purpose underground coal mine research facility used to support research for the development and evaluation of new health and safety interventions for mine workers. Its 4 miles of underground workings have been utilized extensively from the pioneer stages of coal mine health and safety research until the present day. The Experimental Coal Mine consists of 2 drift entries driven into the Pittsburgh coal seam developed to support full-scale mine explosion tests. The Safety Research Coal Mine is a room-and-pillar operation approximately the size of a working section of a coal mine and is utilized for mine health and safety research in areas such as ground control, ventilation, fires, explosives use, materials handling, and environmental monitoring. A full-time staff of miners provides technical and physical assistance to in-house and contract researchers.

Strategic Goals: Cumulative injuries; Ground control; Hearing loss; Mine disasters; Respiratory diseases
Site: Pittsburgh Research Laboratory
Laboratories: Toxic Fumes Laboratory (Underground)

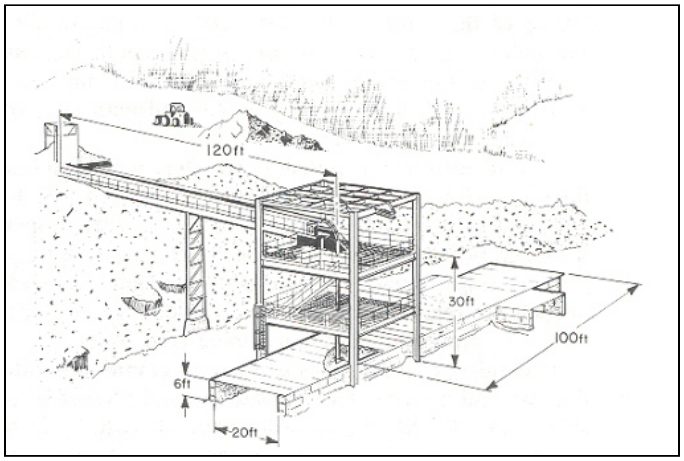
NIOSH Mining Facility

Simulated Underground Mine Facility

The Simulated Underground Mine Facility is a surface structure that simulates an underground coal mine entry. It's used to evaluate remote material injection methods for seal, bulkhead, or roof support construction. It's also used to evaluate suppression foams and other inert gas techniques for fire fighting. The structure can also be used as a test site for other underground mining research projects before full-scale testing in the experimental mine or a commercial mining operation.

This flexible structure simulates up to 10-in diameter borehole drilled into a mine void. The structure consists of a 3-story, 30-ft by 30-ft steel tower with two elevated working platforms and a simulated underground mine below. Access to the working platforms is by a catwalk on the elevated conveyor bridge. The conveyor bridge provides the supporting structure for a 24-in conveyor belt, a 6-in conveying pipeline and utility conduits. The simulated borehole can be configured to extend from either the upper or lower platform to the mine roof. A 1½-ton hoist located above the borehole is used to lower casing or other tools into the borehole. The simulated mine is constructed as needed from interlocking concrete block with removable steel bridge planks serving as the mine roof.

Strategic Goals: Mine disasters
Site: Lake Lynn Laboratory



A schematic of the Simulated Underground Mine Facility

NIOSH Mining Laboratory

Acoustical Testing Laboratory

Determining sound power level in a reverberant field is one of several methods available to calculate the noise emission of equipment. Per ISO acoustics standards for determining sound power in reverberant fields (ISO 3741 - precision grade measurements or 3743-2 - engineering grade measurements), the device under test should be a small percentage of the volume of the test chamber. This reverberation chamber has a volume of roughly 1,300 cubic meters, four times the size of what is considered to be a large chamber. Thus, the chamber is ideal for sound power level testing of the large equipment typically found in mining and construction environments. Further, a state of the art data collection, analysis, and reporting system allows for a significant amount of testing in a short period of time. Currently, NIOSH is actively pursuing NVLAP accreditation of the facility per the ISO 3741 standard.

Strategic Goals: Hearing loss
Site: Pittsburgh Research Laboratory
Building: 154
Equipment: Bruel & Kjaer PULSE Multi-Analyzer System

Sound power measurements on a Fletcher HDDR roof bolter in the Acoustical Testing Laboratory

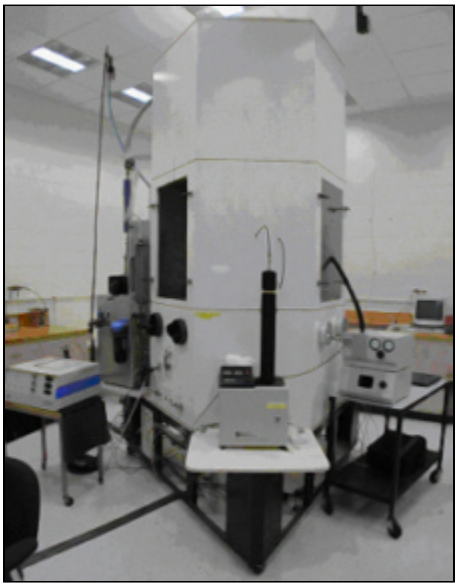
NIOSH Mining Laboratory

Aerosol Physics Laboratory

The Aerosol Physics Laboratory is a 600 sq ft humidity and temperature controlled laboratory. The lab contains a Marple Aerosol Chamber, which is a specially designed apparatus used to create a very uniform distribution of various sized aerosols. The chamber is capable of producing a highly stable aerosol concentration that is essential when attempting to compare the aerosol sampling performance of various instruments. Uniformity of aerosol exposure is enhanced by a rotational platform in the chamber that slowly moves all instruments through equivalent areas of the chamber.

Ancillary equipment to support the chamber includes: Two TSI Inc. model 3400 Fluidized Bed Aerosol Generators, TSI Inc. model 3012 Radioactive Charge Neutralizer, TSI Inc. model 3321Aerodynamic Particle Sizer (APS), TSI Inc. model 3302A Aerosol Diluter, TSI Inc. model 3080 Electrostatic Classifier, Miller Nelson Research Inc. model HCS-401 Flow Temperature and Humidity Control System, R&P Co. Inc. model 1400A Ambient Particulate Monitor, MSP Corp. model M-03 Multi Orifice Ultra Low Pressure Impactor (MOUDI), Air flow controllers and calibration equipment. The laboratory also contains other aerosol generation and sampling equipment. It is used for the staging area for assembly and calibration of personal sampling equipment used for field evaluations.

Strategic Goals: Respiratory diseases
Site: Pittsburgh Research Laboratory
Building: 144



Marple chamber with a tapered element oscillating microbalance (TEOM) in the foreground, aerosol particle sizer (APS) to the right, and Flow Temperature Humidity Control System to the left

NIOSH Mining Laboratory

Auditory Research Laboratory

The Auditory Research Laboratory houses a double-wall sound-treated room and a hearing-protector test chamber for conducting hearing loss research. The quieted room is used for screening and/or evaluating human research subjects and conducting experiments where background sound levels must be kept at a minimum. The hearing protector test chamber is used to test the attenuation of hearing protectors and to research issues related to hearing protector usage and performance.

Strategic Goals: Hearing loss
Site: Pittsburgh Research Laboratory
Building: 154

Subject testing for evaluation of ESP microphones/hearing protectors

NIOSH Mining Laboratory

Chemistry Laboratory

The Chemistry Laboratory is capable of conducting a range of wet chemistry techniques that have been recently used to develop both lab-based and field-portable analytical methods. Additionally, the laboratory is equipped with an inductively-coupled plasma-atomic emission spectrometer (ICP-AES) and an inductively-coupled plasma-mass spectrometer (ICP-MS) capable of determining the chemical composition of any material.

Site: Spokane Research Laboratory
Equipment: ICP Plasma Spectrometers

The Chemistry Laboratory allows a range of analytical tests

NIOSH Mining Laboratory

Diesel/Aerosol Research Laboratory

The Diesel/Aerosol Research Laboratory is capable of generating diesel particulate matter (dpm) or other aerosols within an isolated Marple chamber. Particulate emissions within this chamber closely simulate dpm and dusts found in an operating underground mine. This laboratory is equipped with a tapered element oscillating microbalance for determining dust mass and other instruments that permit measurement of particle size distribution and concentration. It also contains carbon analyzers to perform NIOSH 5040 on field and laboratory samples. The laboratory supports the investigation of dpm sampling and measurement concerns, the development and production of size selective samplers, and other projects concerning exposure to diesel emissions.

Strategic Goals: Respiratory diseases
Site: Pittsburgh Research Laboratory
Building: 150

A marple chamber is used to simulate an aerosol atmosphere found in underground mines

NIOSH Mining Laboratory

Dynamic Materials Testing Laboratory

The Dynamic Materials Testing Laboratory was developed to characterize the response of rock to explosive loading. Here, researchers measure properties under dynamic loads ranging from low-energy acoustic waves to intense stress pulses created by a gas gun to tests driven by full-scale explosive charges. Sophisticated electronics are available for monitoring dynamic response at sampling frequencies up to 10 MHz. The laboratory building, established in a structure originally used as a Nike missile silo, is a revetment with thick concrete walls and floor and is situated in a remote area east of Spokane. Exterior locations are suitable for explosive charge tests and full-scale diamond drilling of samples. Overall, the laboratory is ideally situated for conducting a wide range of very dynamic tests with little risk of disturbing the neighborhood.

Strategic Goals: Ground control
Site: Missile Site
Equipment: 60 mm Split Hopkinson Pressure Bar

Researcher conducting experiment in the Dynamic Materials Testing Laboratory

NIOSH Mining Laboratory

Full Scale Continuous Miner Dust Gallery

Evaluating technologies to control respirable dust and face gas levels can be difficult in an underground mine environment. Such assessments can be easily confounded when variations in dust control and ventilation factors such as curtain airflow and water pressure mask the true effectiveness of the technology being tested. Testing in the full scale continuous miner facility provides tight control of these factors so that any variations in dust and gas concentrations can be attributed more to the specific use of one or more control technologies. Having been evaluated under controlled test conditions and shown to reduce dust and gas levels, these technologies can be employed in an underground mine environment with more certainty that improved control will result.

Strategic Goals: Respiratory diseases
Site: Pittsburgh Research Laboratory
Building: 151

Mining machine in the Full Scale Continuous Miner Dust Gallery

NIOSH Mining Laboratory

Full Scale Face Ventilation Gallery

The full-scale gallery is designed to simulate face ventilation in mining entries having a 7-ft mining height and widths up to 16½ ft. An exhaust fan draws air into the gallery and curtains or tubing are used to direct air to the face of the entry. A full-scale model mining machine, equipped with water sprays and dust scrubber, and a roof bolting machine are used to determine the effects of face equipment on ventilation.

To evaluate how selected face ventilation systems affect gas distributions near the face, methane is released from a pipe manifold located at the entry face and measured at 16 locations with methanometers. The measurements are recorded with a computer-based data acquisition system. The speed and direction of airflow near the face is determined with ultrasonic anemometers. A computer program, written specifically for research in the ventilation gallery, is used for airflow data collection.

Strategic Goals: Mine disasters
Site: Pittsburgh Research Laboratory
Building: 175, 165

Full Scale Face Ventilation Gallery

NIOSH Mining Laboratory

Full Scale Longwall Dust Gallery

The Full Scale Longwall Dust Gallery is used to conduct tests of engineering control technologies in a controlled environment where the complexity or length of the testing would prohibit evaluation in an operating mine. After controls are optimized in the gallery, implementation and testing is then conducted in underground mines.

The gallery is 125 feet in length and represents a segment of a longwall mining face. Full-scale wooden models of a shearer, 25 shields and a panline are used to simulate longwall mining equipment. Coal dust is injected into the face near both cutting drums on the shearer and in the panline to simulate dust liberated during the cutting and transport of coal from the mining face. Various operating parameters can be changed to evaluate their impact on dust liberation and control. Mining height, spray system design, face air flow, water quantity and pressure to sprays, and cutting direction can be varied to study the impact on dust levels. A number of operating parameters, including air velocity, water pressure, and dust levels, are monitored real-time during testing from the control room to ensure valid test conditions are maintained. Gravimetric and instantaneous dust sampling is utilized to quantify changes in airborne respirable dust.

Strategic Goals: Respiratory diseases
Site: Pittsburgh Research Laboratory
Building: 151

Adjusting water pressure on a shearer at the Full Scale Longwall Dust Gallery

NIOSH Mining Laboratory

Gas Content Testing Laboratory

The Gas Content Testing Laboratory is designed to conduct in-house gas content testing of coal cores in accordance with NIOSH´s Modified Direct Method (MDM) testing procedure. The portable modified direct method testing apparatus is designed for both laboratory and field use. The Laboratory meets or exceeds the minimum testing requirements of the NIOSH patented MDM testing apparatus and procedure. After coal samples are collected in the field, they are returned to the gas content testing laboratory where sample containers are stored in a stable, temperature controlled environment for the duration of the test. The laboratory includes test benches and storage space for the MDM apparatus and associated equipment and supplies needed to conduct the gas content tests. Two activities related to gas desorption volume monitoring are also performed in the gas content testing laboratory. Coal core sample containers are leak tested in the lab using pressurized gas prior to the sample container going into the field. Pressurized gas is also used in the canister free space determination procedure that is a component of the total gas content calculation method. After the gas desorption volume monitoring of the samples is completed, the coal core samples are crushed in a Siebtechnik puck and ring mill to determine the residual gas content left in the sample. The Siebtechnik puck and ring mill is housed in a separate room within the Gas Content Testing Laboratory.

Strategic Goals: Mine disasters
Site: Pittsburgh Research Laboratory
Building: 118

NIOSH researcher conducting gas content test using the Modified Direct Method apparatus

NIOSH Mining Laboratory

Hearing Loss Prevention Unit

The Hearing Loss Prevention Unit (HLPU) is a mobile lab for taking NIOSH Mining hearing loss prevention research to workers and their families. On the outside, it is a 32-foot trailer towed by a heavy-duty pickup truck. Inside the sound-insulated trailer is a full hearing research clinic consisting of a four-person testing booth and a training/counseling area. It contains instruments to perform extensive hearing valuations, a one-of-a-kind system that fit-tests hearing protectors for four people at once, and computers to control all of the instruments. The laboratory also contains an audiovisual training system.

The HLPU can be configured to perform a wide range of research tasks. It has been used to perform experiments on a new earplug insertion technique, evaluate a training program using hearing test feedback, and support a study on more effective hearing loss prevention programs.

Strategic Goals: Hearing loss
Site: Pittsburgh Research Laboratory

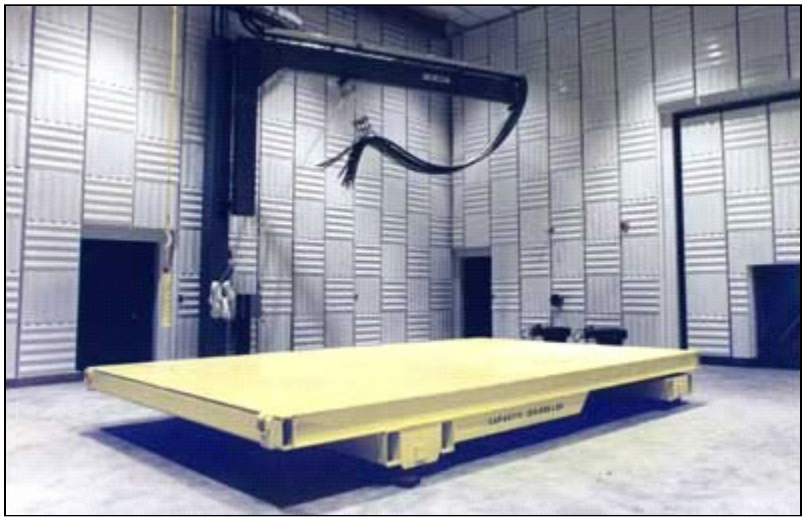
The Hearing Loss Prevention Unit mobile laboratory

NIOSH Mining Laboratory

Hemi-Anechoic Laboratory

This new laboratory will utilize Supersoft Panels on the walls and ceiling to yield a free-field over a reflecting plane. The interior dimensions of the room will be approximately 17.7 meters long by 10.4 meters wide by 7.0 meters high, approximately 1.300 cubic meters. The chamber should meet the requirements of the ISO 3744 standard down to approximately 100 Hz. Initially, the hemi-anechoic chamber will be equipped with a Bruel & Kjaer Pulse data acquisition system with 40 inputs and 2 output channels. This chamber will be utilized primarily for noise source identification testing. In addition, the hemi-anechoic chamber may be used to measure sound power levels according to ISO 3744. This chamber is expected to be completed in April, 2006.

Strategic Goals: Hearing loss
Site: Pittsburgh Research Laboratory
Building: 153



Representation of the Hemi-Anechoic Laboratory

NIOSH Mining Laboratory

Human Factors Engineering Laboratory

The Human Factors Engineering Laboratory at the Spokane Research Laboratory provides unique capabilities to evaluate and reduce musculoskeletal injuries resulting from improper design of mobile equipment used in mining, construction and agriculture industries. A large shock testing machine, accelerometers and data loggers (from Lansmont and NexGen Ergonomics) enable researchers to characterize vibration and shock exposures in the field and laboratory settings. The laboratory also has an AMTI force platform that is capable of studying landing forces (as operator exits from the cab) and postural stability (which can be compromised after exposure to whole-body vibration). Ergonomic software is available to perform occupational ergonomics and biomechanics evaluation.

Strategic Goals: Cumulative injuries
Site: Spokane Research Laboratory
Equipment: IMPAC 3636 Mark II Free Fall Shock Testing Machine ; AMTI Biomechanics Platform

Human Factors Engineering Laboratory at SRL

NIOSH Mining Laboratory

Hydrostatic Testing Chambers for Mine Seals

Two large-scale underground chambers in the Lake Lynn Experimental Mine are used to conduct pneumatic, hydrostatic, or explosion pressure loading of candidate seals for Mine Safety and Health Administration (MSHA) approval. Besides serving as a NIOSH research laboratory, the hydrostatic test chambers were designed to demonstrate a less costly alternative to full scale explosion tests and to provide the industry with a test procedure that can be used at individual mine sites for site-specific testing of candidate seals.

The largest chamber is 29.9 ft wide by 15.1 ft high by 10.2 ft deep with a maximum cross-sectional area of 452 ft^2. The smaller chamber is 20 ft wide by 7.9 ft high by 10.2 ft deep and can accommodate a seal design with a cross-sectional area up to 158 ft^2. Each chamber is connected to a diesel driven air compressor which is used to conduct the pre- and post-explosion leakage measurements and to pressure load seal designs up to 20 psi. An electric water pump capable of 100 gpm at 100 psi at the chamber inlet is fed from an underground 130,000 gal reservoir for the hydrostatic tests, and a methane and oxygen injection system is available for conducting methane-air explosion studies. The two chambers are equipped with internal 0-200 psi strain gauge pressure transducers (1000 Hz) for measuring the internal explosion pressure history and an array of spring-loaded linear variable displacement transducers (LVDT) to measure the displacement of the candidate seal. Data are recorded at 2000 samples per second per channel with a WINDAQ PC-based data acquisition system.

Strategic Goals: Mine disasters
Site: Lake Lynn Laboratory
Facility: Lake Lynn Experimental Mine

Failure of a 4 foot thick cementitious type pumpable seal

NIOSH Mining Laboratory

Industrial Hygiene Laboratory

The purpose of this laboratory is to sustain industrial hygiene field investigations and projects. When evaluating health hazards in the workplace, the researcher will observe with his or her senses and collect data by obtaining samples of material in the work environment and measure the work conditions. Obtaining samples and taking measurements requires the proper equipment, supplies, and other tools to carry out the exposure assessment. Oftentimes, these items will require periodic maintenance, repairs, and calibration in order to function properly and provide reproducible, dependable, and legally defensible data.

The Industrial Hygiene Laboratory includes a variety of equipment designed to provide data on industrial contaminants or environmental conditions that may be harmful to workers. Specific equipment includes: air pumps, size selective particle samplers, particle analyzers, ventilation monitors, heat stress and heat strain monitors, noise monitors, monitors for a variety of gasses, and calibration standards.

Site: Spokane Research Laboratory

Equipment in Industrial Hygiene Lab used to monitor workplace environments

NIOSH Mining Laboratory

Instrumentation Laboratory

The Instrumentation Laboratory is used for the application of strain gauge technology to a variety of surfaces in order to determine the amount of force being exerted on that material during field testing and experimentation. This is essential for determining both static and dynamic loads being applied to rock structures and prototype equipment. The laboratory has the capability to apply strain gauges, either by spot welding or by gluing, to a variety of surfaces to include steel, aluminum, rock samples, etc. The laboratory also has the capability to wire the gauges to electronic connectors that are compatible with various data-loggers that capture strain data over extended periods of time. The equipment in the laboratory includes various types of soldering tools, small tweezers and probes to apply and wire strain gauges and ovens to cure the special epoxy cement used in applying the strain gauges.

Strategic Goals: Ground control
Site: Spokane Research Laboratory

Data gathering instruments being designed and constructed

NIOSH Mining Laboratory

Lake Lynn Cannon Gallery

The Lake Lynn Cannon Gallery (LLCG) is a 22 ft long by 8 ft diameter horizontal steel cylinder open at both ends. Mounted inside the LLCG near one end is a 5 ft long by 2 ft diameter steel cannon with a 2.25 in diameter by 4 ft long bore. The steel cannon can be easily removed from the gallery to facilitate other types of dust and/or gas ignition studies or demonstrations. The gallery has 15 pair shielded instrumentation cable and 120 vac power lines available which extend to a control shed located approximately 300 ft away and protected behind an earth berm. Natural gas is also plumbed to the gallery with a metering system located at the control shed. Gas sampling and video lines extend from the gallery back to the control shed. In a standard LLCG experiment, the flame and combustion products from a detonating explosive charge exit the cannon toward the geometric center of the gallery, where combustible dust has been pre-dispersed and/or an atmosphere of flammable methane-air is present.

Strategic Goals: Mine disasters
Site: Lake Lynn Laboratory
Facility: Explosives Testing Site (Upper Quarry)

Coal dust ignited by unstemmed ammonium nitrate - fuel oil (ANFO) at the Lake Lynn Cannon Gallery

NIOSH Mining Laboratory

Lake Lynn Diesel Laboratory

The Lake Lynn Diesel Laboratory is an in-mine setting which allows for controlled laboratory quality studies in an actual mine environment. The core of the lab is the NIOSH Mobile Engine Emissions Laboratory (MEEL), which is developed around two dynamometer/engine systems. The smaller dynamometer is coupled to a naturally aspirated, mechanically controlled Isuzu C240 diesel engine. The larger dynamometer is coupled to a modern, electronically controlled, turbocharged Mercedes Benz OM904 engine. Each of the dynamometer/engine systems and all accompanying equipment are mounted on the base plate and on a custom built trailer that provides needed mobility. The MEEL is currently integrated into D drift of LLL that serves as a full-flow constant volume sampling (CVS) dilution tunnel. The state-of-the-art equipment and instrumentation are used for characterization of aerosols and gases emitted by tested engines in mine air.

The NIOSH MEEL offer a unique environment for field-evaluation of diesel emissions control technologies and their effects on quality of the air and workers exposure to diesel particulate matter and gases. This facility is currently used to conduct research on physical and chemical characterization of ultrafine and nanometer aerosols emitted by diesel engines in actual occupational settings and establishing role of nano-particles in COPD and other occupational diseases.

Strategic Goals: Respiratory diseases
Site: Lake Lynn Laboratory
Facility: Lake Lynn Experimental Mine

Mobile Engine Emissions Laboratory installed at the Lake Lynn Diesel Laboratory

NIOSH Mining Laboratory

Microbalance Laboratory

Stable ambient air is an essential requirement for accurate weighing. In response to this need, NIOSH staff designed and constructed this insulated 20′x20′x10′ facility which is equipped with a recirculating Liebert computer room HVAC system and HEPA filtration. The weigh room is divided into 2 chambers of 2:1 ratio. The smaller chamber serves as an airlock for entering as well as a buffer for the conditioned air. The buffered air is dispersed into the larger chamber through a perforated grill ceiling for even dispersion. The chamber houses two Cahn & four Mettler microbalances. Control filters are maintained to track balance performance and the long-term balance precision is approximately 5 micrograms.

Strategic Goals: Respiratory diseases
Site: Pittsburgh Research Laboratory
Building: 144

Microbalance Laboratory

NIOSH Mining Laboratory

Mine Electrical Laboratory

The Mine Electrical Laboratory supports full-scale testing of mine (and other industrial) electrical power system components, such as cables, motors, circuit breakers, and fuses, as well as experiments involving electrical safety equipment. It is equipped with electrical power supplies capable of delivering high voltage (up to 100 kV ac or dc) and high current (up to 50 kA ac), instrumentation that is regularly calibrated to NIST traceable standards, and a secure control room from which tests and experiments can be controlled and observed safely. It has been used for projects examining mining safety issues such as fuse performance, electric motor failure, trolley system faults, electric motor circuit protection, electrical cable performance, and overhead power line hazards. The Mine Electrical Laboratory can also be utilized when responding to requests for technical assistance by the Mine Safety and Health Administration, private industry, and other NIOSH divisions.

Strategic Goals: Traumatic injuries
Site: Pittsburgh Research Laboratory
Building: 151
Equipment: Hipotronics 750-KVA Three-Phase and DC Power Source ; Robotron 50-KA High Current Source ; Hipotronics 100-KV AC and DC High Voltage Sources

A mine electrical cable overload experiment in the Mine Electrical Laboratory

NIOSH Mining Laboratory

Motion Analysis Laboratory

Data on human movement is useful for simulation modeling (using virtual humans) and for biomechanical studies. Force plates measure forces at the feet which, when combined with motion data from the motion analysis capture system, provide information regarding the loads experienced by the joints of the body during work activities. EMG equipment measures muscle activity, which is used to estimate muscular fatigue and the force needed to perform a task. This laboratory allows researchers to test new methods of performing work under controlled conditions, so that physical stresses can be minimized and injury risk can be reduced. Specific equipment located in this laboratory includes: Motion AnalysisCorporation 12 camera Eagle System, Noraxon TeleMyo 2400R 16 Channel Base System, Biometrics Portable 4 Channel EMG System SX2300 (4), Biometrics Dual Axis Goniometers, and K100 Amplifier Base Unit.

Strategic Goals: Cumulative injuries; Traumatic injuries
Site: Pittsburgh Research Laboratory
Building: 152
Equipment: Motion Analysis Eagle i Motion Analysis Capture System

Researchers calibrating the motion analysis system

NIOSH Mining Laboratory

MTS Rock Mechanics Testing Laboratory

Small scale material tests are performed in accordance to the ASTM Testing Methods in the state-of-the-art MTS Rock Mechanics Testing Laboratory. This laboratory includes a servo-controlled MTS load frame and the equipment to perform uniaxial and triaxial tests on samples that range in size from 1 to 20-inches in diameter. Small scale material tests are performed to support large scale field programs and provide input parameters for numerical modeling efforts.

Strategic Goals: Ground control
Site: Pittsburgh Research Laboratory
Building: 156
Equipment: Servo Controlled MTS Load Frame

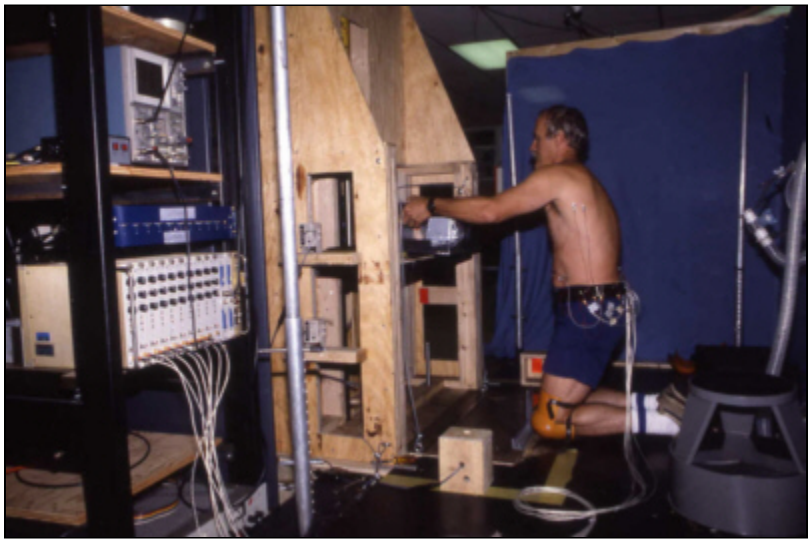
MTS Rock Mechanics Testing Laboratory

NIOSH Mining Laboratory

Physical Strength Laboratory

Tests of physical strength are an important assessment tool for ergonomists studying the effort required of workers performing manual materials handling tasks. In some cases, the task demands may approach or even exceed the strength that an individual is voluntarily willing to exert in a test of strength. In such cases, the likelihood of injury is significantly greater than when the task demands lie well within an individual's strength capacity. Because the relationship between strength capabilities, job demands and musculoskeletal injury has been established, tests of muscular strength may be of benefit in redesigning jobs so they are within the capability limits of mine workers. The lab has machines to test a wide range of static strengths (measured with a joint set at a specific angle) and dynamic strength (measured throughout the range of motion of a joint). Specific equipment located in this laboratory includes: BIODEX System, AMTI OR6-5 Force Plate, Lumbar Motion Monitor II, Chatillon CSD 300 Series Digital Dynamometer, Chatillon DFA-R-ND Digital Force Gauge (50 and 500 lb attachments), Static Lift Platform, Polar HR Monitor S810i, The Human Solution ErgoKit, and GPM Anthropometric Calipers.

Strategic Goals: Cumulative injuries
Site: Pittsburgh Research Laboratory
Building: 152



A subject performs a psychophysical test of strength in the Physical Strength Laboratory

NIOSH Mining Laboratory

Safety Structures Testing Laboratory

The Safety Structures Testing Laboratory is dedicated to large scale material and structural testing relating to the prevention of roof and rib falls. The focal point of the SST laboratory is the Mine Roof Simulator (MRS) load frame that is designed to simulate the extreme weight and movement of the overburden rock that must be supported when coal or other minerals are extracted from the earth. It is the largest load frame of its kind in the world and is the only load frame that can simulate the complex behavior of rock masses at great depths below the surface.

Strategic Goals: Ground control
Site: Pittsburgh Research Laboratory
Building: 155
Equipment: Mine Roof Simulator

Safety Structures Testing Laboratory

NIOSH Mining Laboratory

Seismic Laboratory

The Seismic Laboratory supports field measurements and analyses of seismic event activity produced by dynamic rock mass failures in the mining workplace. Seismic data acquisition, analysis, and display systems are configured using modular PC hardware and software components distributed over wired or wireless networks. Novel methods for remote detection of ground fall instabilities using laser techniques are also investigated.

Strategic Goals: Ground control
Site: Spokane Research Laboratory

Equipment used to measure and analyze seismic events

NIOSH Mining Laboratory

Sensors Laboratory

The Sensors Laboratory is well equipped to test emerging smart-wearable sensors technology for use in hazardous environments. A wide range of wireless sensors for physiologic, environmental, and personnel tracking applications and the associated ad-hoc/mesh networks can be tested. Research focuses on 1) developing new knowledge for correlating the sensor data to assessed risk, 2) adapting the sensors and networks to the mining environment, and 3) using biometric data such as posture, trunk and knee flexion, joint angles, and moments to identify hazards and quantify risk. Wearable sensor solutions will empower miners to take necessary steps to eliminate/reduce their risk to hazards produced by an ever-changing and unpredictable hazardous work environment in real-time.

Strategic Goals: Traumatic injuries
Site: Pittsburgh Research Laboratory
Building: 152

Researcher testing wireless network. Inset shows typical wearable sensor

NIOSH Mining Laboratory

Soil/Rock Properties Laboratory

The Soil/Rock Properties Laboratory is contained in the soils bay, a 4,700 sq ft facility that provides space and equipment for preparing, characterizing, and testing consolidated and unconsolidated materials. The laboratory provides the capability to wash, screen, dry, and mix unconsolidated materials such as soils prior to testing. Consolidated or cemented materials and rock are tested for various engineering properties using a suite of test frames in the laboratory.

The laboratory contains a 70 sq ft wet cure room equipped to fog-cure cementicious samples prior to testing. Depending on the samples' components or the required curing timeframe, the room provides space for large-sized samples as well as a large number of samples. The laboratory is also equipped with a million pound compression test frame, direct shear test frame, programmable controlled tension-compression test frame, three tension-compression test frames, and a fiber panel testing device.

Strategic Goals: Ground control
Site: Spokane Research Laboratory
Equipment: Million Pound Compression Test Frame ; Direct Shear Test Frame ; Programmable Controlled Tension-Compression Test Frame ; Tension-Compression Test Frames ; Fiber Panel Testing Device

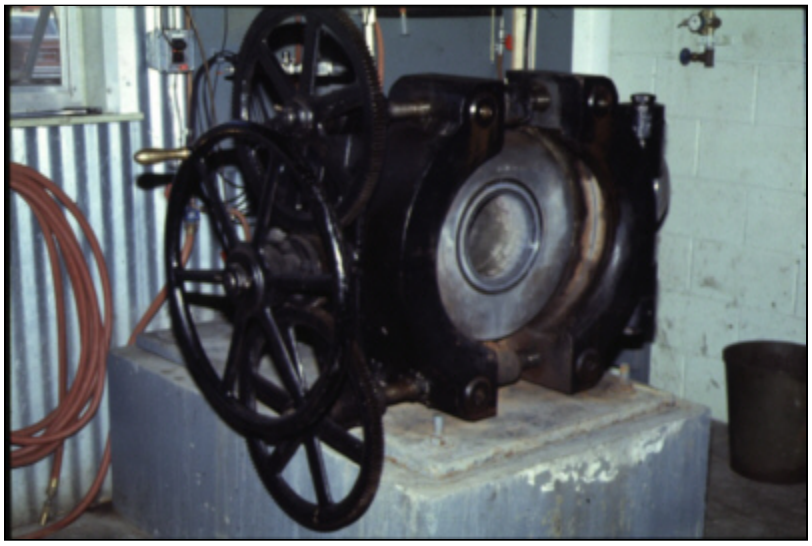
Wet cure room at the Soil/Rock Properties Laboratory

NIOSH Mining Laboratory

Toxic Fumes Laboratory (Surface)

The surface Toxic Fumes Laboratory houses facilities for determining the toxic fumes produced by high explosives. The laboratory contains a variety of equipment for measuring the fumes produced by new candidate permissible explosives pursurant to approval by the Mine Safety and Health Administration, for measuring the fumes produced by other high explosives pursuant to determination of their IME fumes class, and for studying the effect of explosives composition and other factors on toxic fumes production.

Strategic Goals: Traumatic injuries
Site: Pittsburgh Research Laboratory
Building: 117
Equipment: Large Fumes Chamber ; Large Spherical Explosion Chamber



The Bichel Gauge is used to determine the IME fumes class of high explosives

NIOSH Mining Laboratory

Toxic Fumes Laboratory (Underground)

To accommodate fume testing of blasting agents, the underground Toxic Fumes Laboratory was constructed in the PRL Experimental Mine for detonating large, confined charges in a controlled volume. It consists of a portion of mine entry (once used for full scale mine explosion research and demonstrations) enclosed between two explosion proof bulkheads. Total volume of the chamber is 9,666 ft^3 (274 m^3). The chamber is equipped with an air circulating system and is vented using the mine's airflow. Up to 10 pound (4.5 kg) charges can be detonated in the chamber using a variety of confinements. Twenty-four 2-inch thick steel plates are suspended around the explosive charge to stop shrapnel that would otherwise seriously damage the chamber. Fumes from the explosive are confined in the chamber and samples are taken for lab analysis.

Strategic Goals: Traumatic injuries
Site: Pittsburgh Research Laboratory
Facility: Safety Research and Experimental Coal Mines

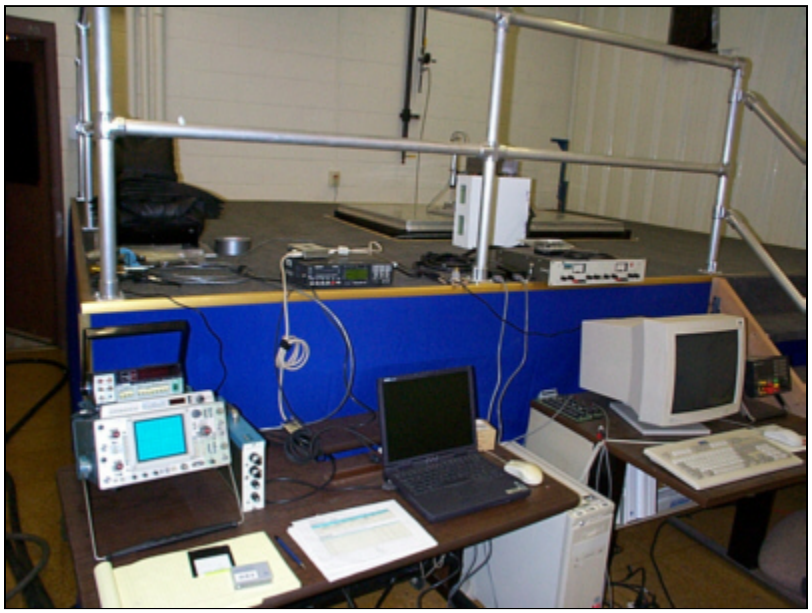
Researcher monitors instrumentation for analyzing toxic fumes produced by a blasting agent detonated in the chamber

NIOSH Mining Laboratory

Whole Body Vibration Laboratory

The Whole Body Vibration Laboratory contains a single axis vibration table that enables researchers to study whole-body vibration. This table is capable of producing vibrations in various waveforms from frequencies below 1 HZ to 15 HZ. The table can produce accelerations in excess of 10G's and has a maximum travel of 6 in. This equipment also has the capability of reproducing vibrations recorded from field tests, once the data has been converted to displacement units. Using this feature, vibrations from computer generated data, either random or specific, can be produced. This capability is useful when simulating vehicle environments. For example, data can be generated to simulate the accelerations of a vehicle's wheel striking a bump or hole. The vibration platform is used in investigations that seek to decrease neck and back injuries and improve machine designs so that equipment operators are isolated from vehicle vibrations and shock loadings. Recent projects evaluate various seat suspension systems and investigate the use of rheonetic technology to improve these systems and increase operator isolation from vibrations. Rheonetic technology has the ability to adjust suspension system damper performance in real time.

Strategic Goals: Cumulative injuries; Traumatic injuries
Site: Pittsburgh Research Laboratory
Building: 152
Equipment: Vibration Table



Whole Body Vibration Laboratory

NIOSH Mining Major Equipment

20-Liter Explosion Chamber

The 20-liter chamber is used to conduct research on the explosion hazards associated with dusts, gases, and hybrid mixtures encountered in the mining industry. It can measure explosion characteristics such as flammability limits, explosion pressures, rates of pressure rise, and explosion temperatures. Associated instrumentation includes pressure transducers, optical dust probes to measure dust dispersion, and infrared pyrometers to measure explosion temperatures. Test data from the various instruments are collected by a high-speed, PC-based data acquisition system. Some of the standard test procedures developed by NIOSH researchers for the 20-liter chamber have been adopted by ASTM International as part of its consensus standard test methods for measuring explosion characteristics. Explosion test chambers based on this design are used by several other government agencies and private testing laboratories to evaluate explosion hazards in other industries.

Strategic Goals: Mine disasters
Quantity: 2
Site: Pittsburgh Research Laboratory
Building: 143

Dust explosion venting from 20-liter chamber

NIOSH Mining Major Equipment

60 mm Split Hopkinson Pressure Bar

The 60 mm Split Hopkinson Pressure Bar (SHPB) is a unique device, originally built to study oil shale dynamic behavior at Lawrence Livermore National Laboratory. This semi-truck sized device features a Nitrogen gas gun, pressure bars, axial confinement capability and sophisticated monitoring electronics. The SHPB is used to measure the dynamic strength attenuation of materials used in close proximity to blasting, geologic material that is the target of blasts, and adjacent geologic material that will form the back (ceiling) of the new opening. In conjunction with ultrasonic tools, the SHPB can also be used to track accumulation of damage in these materials from repeated dynamic loads.

Strategic Goals: Ground control
Quantity: 1
Site: Missile Site
Laboratory: Dynamic Materials Testing Laboratory

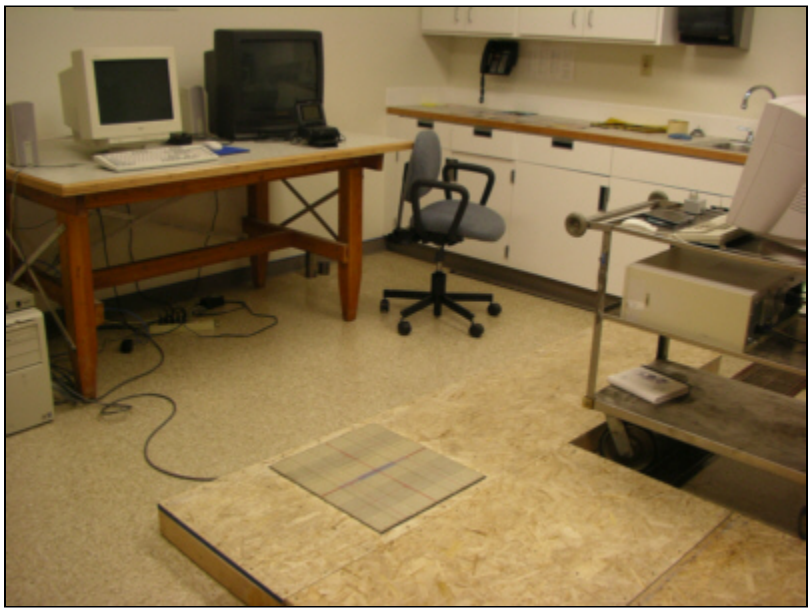
Split Hopkinson Pressure Bar

NIOSH Mining Major Equipment

AMTI Biomechanics Platform

The AMTI biomechanics platform simultaneously measures three force and three moment components along the X, Y, and Z axes. The forces and moments are measured by strain gauges attached to proprietary load cells near the four corners of the platform. The gauges from six Wheatstone bridges have four active arms, each with eight or more gauges per bridge. Three of the output signals are proportional to the forces parallel to the three axes and the other three outputs are proportional to the moments about the three axes. AMTI´s NetForce software is a flexible data acquisition system designed to facilitate the use of AMTI´s multi-axis force platforms for biomechanics and industrial force measurements. NetForce allows the user to monitor and save data from up to six multi-axis transducers, providing a seamless interface for AMTI´s Ethernet, RS-232, and analog data format products.

Strategic Goals: Cumulative injuries
Quantity: 1
Site: Spokane Research Laboratory
Laboratory: Human Factors Engineering Laboratory



AMTI biomechanics platform

NIOSH Mining Major Equipment

Bruel & Kjaer Investigator 2260 Hand-Held Analyzer

This hand-held 2-channel analyzer is capable of making broadband and real-time octave band measurements. It also offers building acoustics (1 or 2 channel), room acoustics, sound intensity, and narrow band (FFT) analysis with pure tone detection.

Strategic Goals: Hearing loss
Quantity: 1
Site: Pittsburgh Research Laboratory
Building: 154

Hand-held Analyzer B&K Investigator Model 2260

NIOSH Mining Major Equipment

Bruel & Kjaer Investigator 2260 with Sound Intensity Probe

Sound intensity is the time-averaged product of the pressure and particle velocity. A single microphone can measure pressure but it is not a simple process to measure particle velocity. However, the particle velocity can be related to the pressure gradient of a sound field. Using two closely space microphones, it is possible to measure the pressure gradient and relate it to particle velocity using an equation. The portable sound intensity analyzing system consists of a two-microphone probe and an analyzer. The probe measures the pressure at the two microphones and the analyzer does the integration and other calculations that are necessary to find the sound intensity.

Strategic Goals: Hearing loss
Quantity: 1
Site: Pittsburgh Research Laboratory
Building: 155

Bruel & Kjaer 2260 Investigator with sound intensity probe

NIOSH Mining Major Equipment

Bruel & Kjaer PULSE Multi-Analyzer System

This multi-channel system provides real time data collection and analysis. It is a turnkey for ISO 3741 standard for sound power solutions, which is used by several ISO 3741 accredited labs, including the PRL Acoustical Testing Laboratory. The PULSE system comprises PULSE LabShop software that runs under Windows NT, a PC, one or more DSP boards which fit into the PC, a data acquisition front-end, and transducers.

Strategic Goals: Hearing loss
Quantity: 2
Site: Pittsburgh Research Laboratory
Laboratory: Acoustical Testing Laboratory
Building: 154

The PULSE multi-analyzer system from B&K

NIOSH Mining Major Equipment

Direct Shear Test Frame

The large scale direct shear test frame (300,000 pound axial and shear forces) with programmable control is used for biaxial testing on rock, concrete, and soil samples. The sample size can vary from 1 inch diameter rock cores to 14 inch square concrete blocks.

Strategic Goals: Ground control
Quantity: 1
Site: Spokane Research Laboratory
Laboratory: Soil/Rock Properties Laboratory

Testing core samples on the direct shear test frame

NIOSH Mining Major Equipment

Drilling Equipment

The drilling equipment located at the Missile Site includes (a) a mobile trailer mounted drill capable of drilling up to 1,000 feet of 3 inch in diameter hole and 125 feet of hole using 8 inch in diameter hollow stem augers. This drill is used extensively for core drilling, and (b) three underground core drills, one hydraulically powered, and two pneumatically. These drills are used for underground core drilling and installation of in situ measuring instruments.

Strategic Goals: Ground control
Quantity: 4
Site: Missile Site

Mobile trailer-mounted drill

NIOSH Mining Major Equipment

Earthen Bermed Magazines

The PRL explosives magazine area contains four active magazines. One of these is used for storage of blasting caps and the others are used to store explosives. Each magazine is surrounded by an earthen berm. The total capacity of the magazines is 3,300 lb of explosive and 150,000 blasting caps.

Strategic Goals: Traumatic injuries
Quantity: 4
Site: Pittsburgh Research Laboratory

Earthen bermed magazine

NIOSH Mining Major Equipment

Fiber Panel Testing Device

This portable field testing device allows researchers to gather information on initial breaking strengths of shotcrete, particularly if it used near blast areas. These data will provide valuable insight into competence of shotcrete as a support, including optimal fiber mixes for different sites.

Strategic Goals: Ground control
Quantity: 1
Site: Spokane Research Laboratory
Laboratory: Soil/Rock Properties Laboratory

Testing fiber reinforced shotcrete panels at a mine site

NIOSH Mining Major Equipment

Fletcher HDDR-13-C-F Roof Bolting Machine

This Fletcher roof bolting machine is used for a variety of research testing. The HDDR is a duel-boom machine which may be configured for vacuum, mist, or wet drilling. One boom of the HDDR is equipped with a feedback system, which automatically adjusts the drilling configuration (rotation speed, thrust, etc.) to match the drill media geology with the objective of enhancing drilling performance. NIOSH has used the HDDR as a base platform for determining the effect of drilling configuration (bit size, drill steel shape, etc.) on the sound power level emission and the performance of the device. Current testing involves using the HDDR for noise source identification work to determine and rank the most prominent noise sources of a roof bolting machine during a drilling cycle for development of engineering noise controls.

Strategic Goals: Cumulative injuries; Ground control; Hearing loss
Quantity: 1
Site: Pittsburgh Research Laboratory
Building: 152

Fletcher roof bolting machine being tested in PRL´s Acoustical Testing Laboratory

NIOSH Mining Major Equipment

Frictional Ignition Apparatus

Frictional ignitions of methane in the coal mining industry are often caused by the impact of mining machine cutter bits on hard rock (e.g., sandstone) during the coal-cutting process. The Frictional Ignition Apparatus is a useful tool for studying the various mechanisms that cause frictional ignitions and for evaluating methods to reduce the frequency of their occurrence in the underground workplace. Variables that can be evaluated with the apparatus include: bit design, bit attack angle, impact speed, depth of cut, bit wear area, shank metallurgy, and ceramic coatings. The effects of methane concentration and quenching by water sprays can also be studied. The Frictional Ignition Apparatus consists of a section of a continuous miner drum with various bit blocks attached. The drum is enclosed within a plywood chamber (~100 cubic feet) that includes thin plastic blow-out panels to relieve the pressure if an ignition occurs. To conduct a test, the chamber is filled with a flammable methane-air mixture. The drum is operated at a rotational speed of 20 to 40 revolutions per minute. A digital video camera is used to record the number of strikes to ignition and the subsequent frictional ignition of methane. Hot smear temperatures are measured using a high speed infrared camera.

Strategic Goals: Mine disasters
Quantity: 1
Site: Pittsburgh Research Laboratory
Building: 152

Ignition of methane in frictional ignition apparatus

NIOSH Mining Major Equipment

Hipotronics 100-KV AC and DC High Voltage Sources

The Hipotronics 100-kV ac and dc high voltage sources are two electrical power supply systems with adjustable outputs capable of up to 100 kV. These systems utilize mobile oil-immersed transformers and are operated from within the Mine Electrical Laboratory control room. They have been used extensively in research studying the performance and safety of mine electrical cables, including conducting tests of insulation resistance, corona generation, surface tracking, and dielectric strength. They have also been used to generate high-voltage electric fields for experiments involving research to develop a power line contact alarm for mobile equipment.

Strategic Goals: Traumatic injuries
Quantity: 1
Site: Pittsburgh Research Laboratory
Laboratory: Mine Electrical Laboratory
Building: 151

Grounding the output on the 100-KV ac high voltage source after a high voltage field experiment

NIOSH Mining Major Equipment

Hipotronics 750-KVA Three-Phase and DC Power Source

The Hipotronics 750-kVA three-phase and dc power source is a system that can supply electrical power at three-phase voltages up to 13,800 V, and dc voltages up to 700 V. Capable of delivering 750 kVA continuously, the system can supply 1.8 MVA for short durations. It has been used extensively in mine electrical safety research, such as in tests relating current to temperature rise on mine electrical cables, examining the deterioration of electric motors, developing techniques to distinguish between motor starts and short circuits, and evaluating protective relays and explosion-proof enclosures during simulated electrical faults.

Strategic Goals: Traumatic injuries
Quantity: 1
Site: Pittsburgh Research Laboratory
Laboratory: Mine Electrical Laboratory
Building: 151

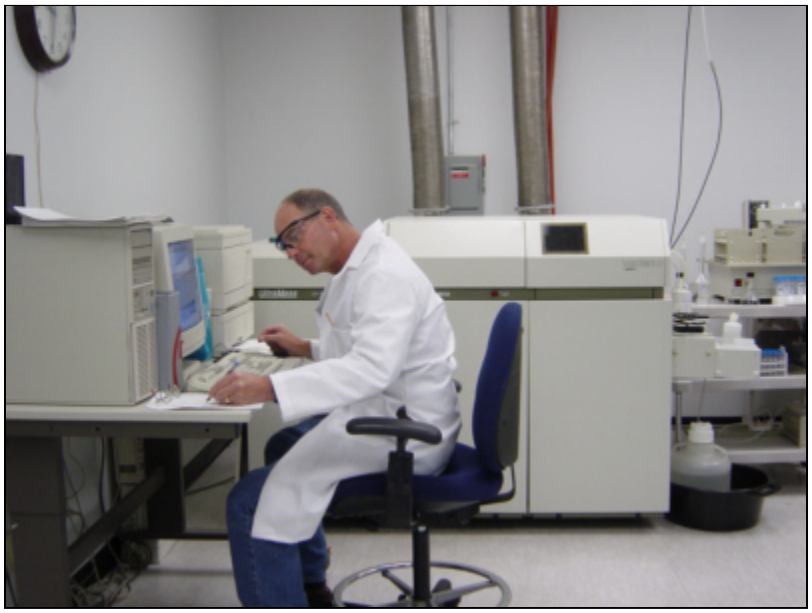
NIOSH engineer adjusts the voltage level on the Hipotronics 750-kVA three-phase and dc power source

NIOSH Mining Major Equipment

ICP Plasma Spectrometers

The Chemistry Laboratory is equipped with an inductively-coupled plasma-atomic emission spectrometer (ICP-AES) and an inductively-coupled plasma-mass spectrometer (ICP-MS). The ICP-AES and ICP-MS are used for elemental chemical analysis of just about any material or substance (waters, biological materials, inorganic materials of all sorts, environmental samples, geological samples, etc.). Samples have to be dissolved prior to analysis. A wide range of concentrations can be measured, down to parts per trillion in solution by the ICP-MS.

Quantity: 2
Site: Spokane Research Laboratory
Laboratory: Chemistry Laboratory



Preparing samples for analysis by the ICP mass spectrometer

NIOSH Mining Major Equipment

IMPAC 3636 Mark II Free Fall Shock Testing Machine

The IMPAC 3636 Mark II free fall shock testing machine, manufactured by MTS Systems Corp., is a free-fall testing machine of unique design for performing a wide range of shock tests. One testing procedure is to simulate impulsive (short duration) forces experienced by heavy equipment operators that may contribute to sprains and strains and other lower back injuries. Once these operator g-forces are characterized in the field, researchers can simulate conditions which could cause injuries on the MTS shock testing machine. Researchers can then design and test engineering controls to reduce operator injury.

Strategic Goals: Cumulative injuries
Quantity: 1
Site: Spokane Research Laboratory
Laboratory: Human Factors Engineering Laboratory

Drop shock testing machine

NIOSH Mining Major Equipment

Joy 14CM9 Continuous Mining Machine

Continuous miners are large underground coal cutting machines that cut the coal at the working faces of coal mines, gather up the cut coal, and transport it via an onboard conveyor to the back of the machine. From there, coal is loaded onto either another conveyor or a piece of mining equipment that carries the coal away from the working face. The 14CM9 is a drum type machine with gathering arms that operates from 1000 volts AC. It also consists of a conveying system with a 30-inch chain. The overall chain length is approximately 60' in length with 54 flights and a chain pitch of 3.25 inches. The miner is capable of operating from either onboard the continuous miner or by radio remote.

This equipment is used by all branches of PRL for various research. Recently, it was used to study remote control mining and to develop and demonstrate a close proximity warning device for continuous miner operators. The miner has and presently is being used to test the effectiveness of noise controls for continuous mining machines in a laboratory environment prior to testing in operating mines.

Strategic Goals: Hearing loss; Traumatic injuries
Quantity: 1
Site: Pittsburgh Research Laboratory
Building: 152

Joy 14CM9 continous miner

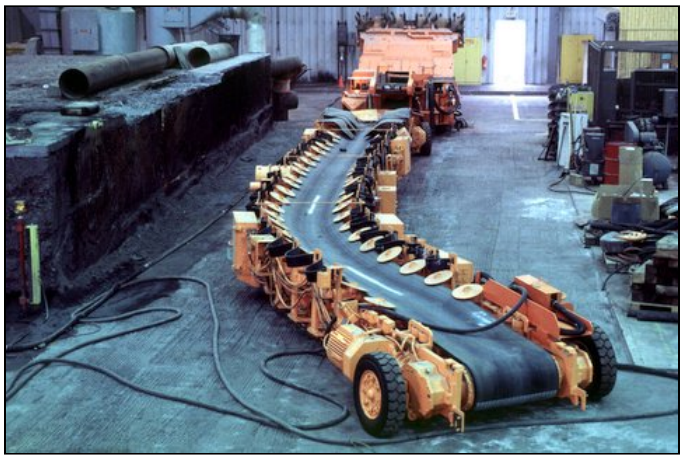
NIOSH Mining Major Equipment

Joy 3FCT-4 Flexible Conveyor Train

The Joy Flexible Conveyor Train (FCT) is a high capacity continuous haulage system that is remotely controlled by one operator. It is a flexible, moving belt system that is used to continuously convey coal from the mine face to the section or main belt. The FCT winds its way through the mine as it follows behind a continuous mining machine that extracts coal. The operator is responsible for maneuvering the FCT throughout the mine and for precisely positioning the receiving end (front hopper) such that coal is discharged from continuous mining machine onto the FCT. Our research uses the 3FCT-4 model. It is available in belt widths of 37" / 940mm and 42" / 1067mm and in system lengths of up to 420 feet / 128 meters. The 3FCT-4 can move forward or reverse at an average of 19.5 meters/minute. The 42" / 1.07m wide flexible belt enables continuous conveyance of coal rates up to 27 tons/minute or 24.5 tonnes/minute.

The 3FCT-4 is used for machine safety research. FCT operators can be in dangerous areas where the roof could fall and where they could be struck or pinned by moving machinery. This situation is made more dangerous because visibility is reduced by dust, obstructions, and low levels of light. Significant levels of noise, especially during the cutting of coal, can impair hearing and communication between the operators.

Strategic Goals: Traumatic injuries
Quantity: 1
Site: Pittsburgh Research Laboratory
Building: 152



The Joy 3FCT-4 continuous haulage system

NIOSH Mining Major Equipment

Large Fumes Chamber

The large fumes chamber is used to determine the toxic fumes produced by a new candidate permissible explosive pursuant to approval by MSHA. The chamber is constructed of 3/4-inch steel with a volume of 1,354 cubic feet or 38.3 cubic meters. One pound of high explosive is loaded into a steel cannon connected to the end of the chamber. The resulting fumes are confined in the chamber for subsequent analysis. The toxic gases measured include NO, NO_2, NO_3, H_2S, SO_2, CO, and CO_2.

Strategic Goals: Mine disasters
Quantity: 1
Site: Pittsburgh Research Laboratory
Laboratory: Toxic Fumes Laboratory (Surface)
Building: 117

Large fumes chamber

NIOSH Mining Major Equipment

Large Spherical Explosion Chamber

The Large Spherical Explosion Chamber is used to study the explosion hazards of gases and to measure the toxic fumes and residue produced from the detonation of solid explosives used in the mining industry. It has a diameter of 12 feet and a volume of 905 cubic feet or 25½ cubic meters. It can be used to measure the explosion pressures and flammability limits (upward and downward propagation) of gases. Research on the fumes produced from the detonation of explosives can be conducted in air or in an inert atmosphere (e.g., argon). Associated instrumentation includes pressure transducers, high speed video cameras, and gas analyzers to measure NO, NO_2, CO, CO_2, O_2, and SO_2. Gas samples are also collected in evacuated tubes for subsequent gas chromatographic analyses for H_2 and heavier hydrocarbons through C_5.

Strategic Goals: Mine disasters
Quantity: 1
Site: Pittsburgh Research Laboratory
Laboratory: Toxic Fumes Laboratory (Surface)
Building: 117

Large Spherical Explosion Chamber

NIOSH Mining Major Equipment

LMS Pimento Portable Noise and Vibration Analyzer

This portable device can simultaneously measure 24 channels of data from microphones, accelerometers, etc. Time data or spectral data may be acquired. In addition, the Pimento may be used to measure frequency response functions of a structure.

Strategic Goals: Hearing loss
Quantity: 1
Site: Pittsburgh Research Laboratory
Building: 154

LMS Pimento portable noise and vibration analyzer

NIOSH Mining Major Equipment

MB Dynamics 110 Electromechanical Shakers

The Modal 110 shakers can be driven by an electrical signal from a data acquisition system to provide a force input to a structure. The resulting sound pressure, sound intensity, and/or surface vibrations can then be measured. These devices can also be used to measure frequency response functions of machinery. The Modal 110 shakers can provide up to 110 lb of input force from dc to 5 kHz. They can be used to pinpoint areas on structures that have the highest vibrations and to determine path of energy flow through structures. They can also combine with NSID techniques to rapidly identify noise sources.

Strategic Goals: Hearing loss
Quantity: 2
Site: Pittsburgh Research Laboratory
Building: 153

MB Dynamics Model 110 electromechanical shaker

NIOSH Mining Major Equipment

Million Pound Compression Test Frame

This compression test frame has a 1,000,000 pound capacity. It is equipped with programmable control and data collection features and is capable of testing specimens up to 6 inches in diameter to determine unconfined compressive strength and rock modulus.

Strategic Goals: Ground control
Quantity: 1
Site: Spokane Research Laboratory
Laboratory: Soil/Rock Properties Laboratory

Million-pound test frame

NIOSH Mining Major Equipment

Mine Roof Simulator

The Mine Roof Simulator provides unique capabilities to evaluate the integrity, stability, and load performance characteristics of large specimen structures and equipment. The simulator´s biaxial load frame can accommodate specimens up to 16 feet high, 20 feet wide, and 20 feet long. Precision load testing is achieved by closed-loop, servo controlled actuators with six degrees of freedom control of the lower platen. Up to 3 million pounds of vertical force can be applied through a 24-inch stroke of the lower platen. Horizontal loads of up to 1.6 million pounds can be applied simultaneously by horizontal displacement of the lower plane through a 16-inch stroke.

Strategic Goals: Ground control
Quantity: 1
Site: Pittsburgh Research Laboratory
Laboratory: Safety Structures Testing Laboratory
Building: 155

Mine Roof Simulator

NIOSH Mining Major Equipment

Mobile Diesel Powered Propeller Fan

The mobile diesel powered propeller fan is a 54-inch Spendrup, three bladed propeller fan that is rated at 60,000 cfm. The fan is powered by a Duetz F2L1011F diesel engine. The unit is mounted on a single axial trailer for highway use, and includes all safety items required by the Mine Safety Health Administration (MSHA) for use in metal/non-metal underground mines. The fan is very useful for performing ventilation research in large-opening mines because it can be transported easily to any mine site location and driven directly to the underground test sites. The transportability of the fan unit greatly decreases our response time to address specific ventilation problems encountered by our stakeholders. Electricity is not always readily available at the required locations of the ventilation tests, and considerable time and effort is often required by the cooperator to provide power to the test sites. The mobile diesel powered propeller fan eliminates logistics problems associated with the use of conventional electric fans, further enhancing the research capability of the unit. The fan has been used to conduct various research tasks in large opening mines related to face ventilation, mine-wide ventilation, and silica dust near an underground stone crusher.

Strategic Goals: Mine disasters; Respiratory diseases
Quantity: 1
Site: Lake Lynn Laboratory
Facility: Lake Lynn Experimental Mine

Portable diesel powered propeller fan

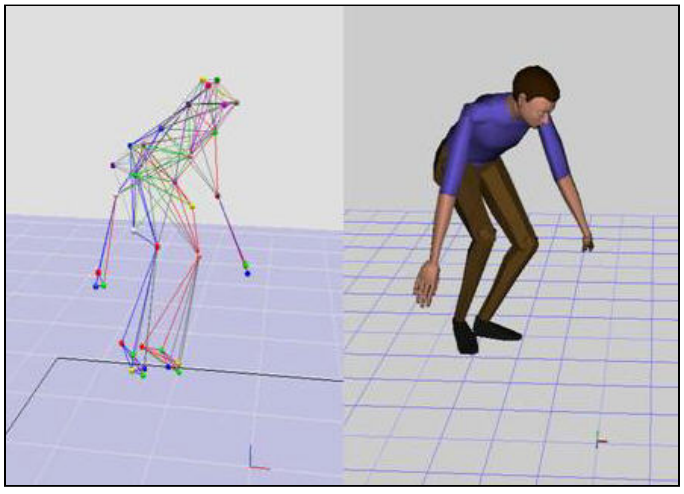
NIOSH Mining Major Equipment

Motion Analysis Eagle i Motion Analysis Capture System

The motion analysis capture system monitors and records a subject´s motions using optical markers on the subject. The resulting data is used to animate many types of digital subjects such as virtual humans and/or CAD models of machines. The gathered data is much more accurate than data from traditional, frame-by-frame animation techniques as it tracks real motions of the actual subject. The application of motion capture is well-documented with many examples from running, walking, spine studies, foot, shoulder, motor control applications, machine-human interaction studies and more.

The Eagle Digital System consists of 12 Eagle Digital Cameras, the EagleHub, and EVaRT software, which can capture complex motion with extreme accuracy. Real-time capabilities allow one to see capture results at the same instant as the subject is performing a specific task. Jack, a motion simulation and analysis software is used. It comes with a module that provides an interface to the motion-capture system. Motions represented by the optical markers are transferred into Jack, where researchers can examine both position and orientation of each motion. Jack can also be used for low back analysis and design of virtual humans.

Strategic Goals: Cumulative injuries; Traumatic injuries
Quantity: 1
Site: Pittsburgh Research Laboratory
Laboratory: Motion Analysis Laboratory
Building: 152



Test subject motion tracked (left) and Jack´s virtual human mapped (right)

NIOSH Mining Major Equipment

OROS OR38 Multi-Analyzer/Recorder

This portable, 8-channel device is capable of making sound level and vibration level measurements in 1/3-octave bands. When used with an intensity probe, this instrument can be used to perform sound intensity measurements.

Strategic Goals: Hearing loss
Quantity: 1
Site: Pittsburgh Research Laboratory
Building: 154

OROS OR38 multi-analyzer/recorder

NIOSH Mining Major Equipment

Programmable Controlled Tension-Compression Test Frame

The tension compression test frame has a 20,000 pound capacity and is equipped with programmable control and data collection. This machine is capable of cyclic loading for earthquake simulation and fatigue evaluations.

Strategic Goals: Ground control
Quantity: 1
Site: Spokane Research Laboratory
Laboratory: Soil/Rock Properties Laboratory

Tension-compression test frame

NIOSH Mining Major Equipment

Robotron 50-KA High Current Source

The Robotron 50-kA high current source is an electrical power supply capable of delivering up to 50 kA ac current with precisely controlled triggering and pulse duration. This power supply features a liquid-cooled transformer and a processor-based output controller. It has been used to examine the thermal characteristics of electrical conductors under short circuit conditions as part of research studying the performance and safety of mine electrical cables. It can also be used to study the performance of circuit over-current protection devices such as fuses and circuit breakers.

Strategic Goals: Traumatic injuries
Quantity: 1
Site: Pittsburgh Research Laboratory
Laboratory: Mine Electrical Laboratory
Building: 151

Attaching an electrical cable to the Robotron 50-kA high current source in preparation for an electrical safety experiment

NIOSH Mining Major Equipment

Scanning Electron Microscope And X-Ray Elemental Analysis System

The Scanning electron microscope (SEM) provides high-resolution electron imaging of burned and unburned coal dust and other particles down to a size of 1 micrometer or less. X-rays generated by the imaging high-energy electron beam are collected and the energy analyzed to determine the elements contained of the material in the image area (or portions thereof) and their relative amounts. Both the electron image and x-ray scans are collected in digital form under PC control and saved in standard formats compatible with standard word processing programs. The images and elemental analyses are used for research purposes in the Ventilation and Explosion Prevention program area to better understand the causes, effects, and mechanisms of explosions. The SEM is also used in forensic studies requested by the Mine Safety and Health Administration in their investigations of coal mine explosions, ignitions, and other incidents. Assistance is also provided to other NIOSH researchers inside and outside PRL who request SEM/x-ray analyses for various research purposes.

Strategic Goals: Mine disasters
Quantity: 1
Site: Pittsburgh Research Laboratory
Building: 143

Scanning electron microscope and x-ray elemental analysis system

NIOSH Mining Major Equipment

Servo Controlled MTS Load Frame

The MTS (Material Testing System) has an axial load capacity of one-million pounds. The servo-controlled system can test specimens in load, stroke, or strain control while the data from LVDT´s (Linear Variable Distance Transducers) are recorded and analyzed in real-time. Sample preparation equipment, including lapidary saws, drills, and grinders, support the research facility while the ASTM Rock Testing Standards are the testing protocol.

Strategic Goals: Ground control
Quantity: 1
Site: Pittsburgh Research Laboratory
Laboratory: MTS Rock Mechanics Testing Laboratory
Building: 156

Servo controlled MTS load frame

NIOSH Mining Major Equipment

Small Scale Burn Tunnels

Two small scale burn tunnels are used to measure fire resistance and flammability of solid combustibles, such as conveyor belting and noise abatement materials. Levels of smoke and toxic gases are also measured in order to assess the relative hazards produced during the combustion of sample materials under forced ventilating air-flow.

The two tunnels have a square cross-sectional area of 0.21 m^2, with one of the tunnels having a length of 7.9 m and the other a length of 4.9 m. The tunnels are connected via transition ducting to an exhaust fan that supplies the forced ventilating air-flow. Adjustable sliding plates within the transition ducting can be used to set ventilation air velocities within the tunnels in the range of 0.5 m/s to 3.0 m/s. Gas sampling ports, located within the transition ducting, are used to extract gas samples for subsequent measurement via on-line, continuous gas analyzers.

Combustible materials are mounted on metal racks and ignited at the open end of the tunnel using a methane-air burner. Samples are typically 0.23 m wide and can be of various lengths. In addition to measuring the gas temperature of the combustion product gases, thermocouples may be imbedded with the materials at fixed distances to determine flame spread rates. The tunnels are also useful for determining the effects of air velocity on their burning characteristics.

Strategic Goals: Mine disasters
Quantity: 2
Site: Lake Lynn Laboratory

Small scale burn tunnel

NIOSH Mining Major Equipment

Temporary Magazine

Explosives received after hours are stored in the temporary magazine until they can be moved to permanent magazine storage.

Strategic Goals: Traumatic injuries
Quantity: 1
Site: Pittsburgh Research Laboratory

Temporary magazine

NIOSH Mining Major Equipment

Tension-Compression Test Frames

Three tension compression test frames are capable of testing specimens up to 24 inches in diameter. Full scale range varies from 25,000 lbs on the small machine to 400,000 lbs on the largest. These machines are used to measure the physical properties of materials.

Strategic Goals: Ground control
Quantity: 3
Site: Spokane Research Laboratory
Laboratory: Soil/Rock Properties Laboratory

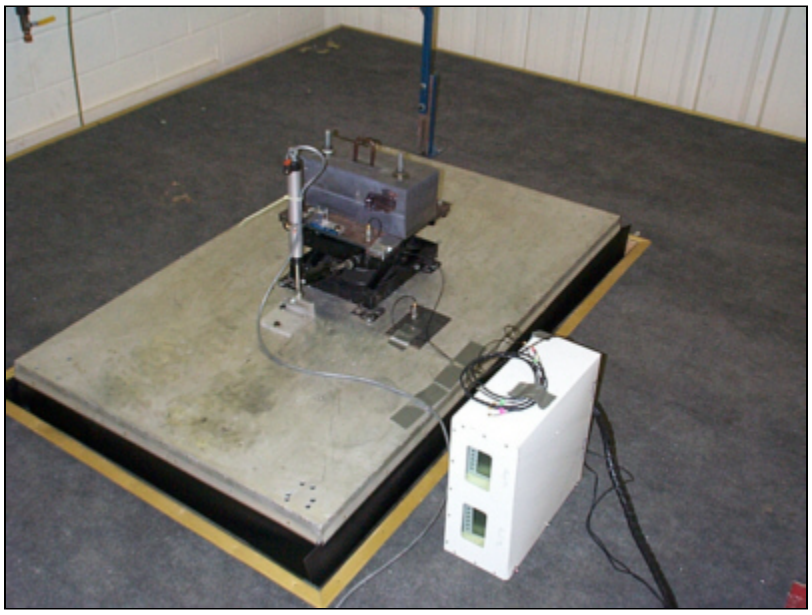
Three tension-compression test frames

NIOSH Mining Major Equipment

Vibration Table

The Whole Body Vibration Laboratory at the Pittsburgh facility contains a single axis vibration table that enables researchers to study whole-body vibration. The table can produce vibrations from computer generated data, either random or specific, in various waveforms from frequencies between 1 - 15 HZ, accelerations in excess of 10G's, and a maximum travel of 6 in. It can also reproduce vibrations recorded from field tests, making it useful for simulating road vibrations

Strategic Goals: Cumulative injuries; Traumatic injuries
Quantity: 1
Site: Pittsburgh Research Laboratory
Laboratory: Whole Body Vibration Laboratory
Building: 153



Vibration table in the Whole Body Vibration Laboratory